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Proximate Analysis and Physico-Chemical Properties of Groundnut (*Arachis hypogaea* L.)

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Abstract: Proximate, physico-chemical and elemental analysis of groundnut were determined. The results showed that the groundnut oil contained 47.00% fat, 38.61% protein, 5.80% moisture, 1.81% carbohydrate, 3.70% crude fibre and 3.08% ash. Minerals (mg/100g) included: Na (42.00±0.71), K (705.11±0.86), Mg (3.98±0.04), Ca (2.28±1.94), Fe (6.97±1.62), Zn (3.20±0.11), P (10.55±0.68). The physico-chemical characteristics showed; saponification value, 193.20mgKOH/g, iodine value 38.71 (g/100g), acid value 5.99 (mgKOH/g), free fatty acid (mgKOH/g) 3.01 peroxide value 1.50 (meq/kg) and refractive index 1.449. The predominant fatty acid was found to be oleic acid (41.11%). The groundnut can thus be considered as a good source of protein with high nutritional value.

Key words: Groundnut oil, chemical composition, physico-chemical characteristics, nutritional value

Introduction

Good nutrition is a basic human right. In order to have a healthy population that can promote development, the relation between food, nutrition and health should be reinforced. In developing countries, one of the ways of achieving this is through the exploitation of available local resources, in order to satisfy the needs of the increasing population (Achu *et al*., 2005). Knowledge of the nutrition value of local dishes, soup ingredients and local foodstuffs is necessary in order to encourage the increase cultivation and consumption of this highly nutritive nut. The consumption will help to supplement the nutrients of the staple carbohydrate foods of the poor who cannot afford enough proteins foods of animal origin (Achu *et al*., 2005). Several studies have been carried out on the chemical and functional properties of kernels and defatted cakes of groundnut (*Arachis hypogaea* L.), an under exploited nut, largely consumed by the western and most populations in Africa. (Weiss, 1983; Bansal *et al*., 1993; Pancholly *et al*., 1978; Ahmed and Young, 1982). They showed these nuts as good source of lipid and protein and the defatted cakes could be used as protein supplement in human nutrition. Groundnuts (*Arachis hypogaea* L.) have various uses:- adds to good nutritional value, as soup thickener and when cooked, roasted, dried or fried serve as snacks. Sometimes, paste used as margarine or butter. Moreso, there are less expensive, widely distributed easily cultivated, consumed and sold by the masses.

Groundnut, *Arachis hypogaea* L. also known as peanut or earthnut is a native to a region in eastern south America (Weiss, 1983). It is grown as an annual crop principally for its edible oil and protein rich kernels seeds, borne in pods which develop and mature below the soil surface. The groundnut, a herbaceous plant of which there are varieties, common in the united states, grow up to 30-46 cm high do not spread. Runner varieties, the most common in the West Africa are shorter and run along the ground for 30-60 cm (Asiedu, 1992). Peanut (*Arachis hypogaea* L.) is now grown world wide in the tropic and temperature zones primarily as an oilseed crop (Bansal *et al*., 1993). Peanut seeds make important contribution to the diet in many countries. The fatty acids composition of the endogenous fats ranges from 22 to 30% (5). and the average oil content may reach 50% (Pancholly *et al*., 1978; Derise *et al*., 1974). These play an important role in determining shelf life, nutrition and flavour of peanuts seeds. Chemical composition of Aboriginal peanut seeds were analyzed (Nelson and Carlos, 1995) among six cultivars, the result showed presence of oil, protein. The fatty acid composition in (g/100g of total fatty acids) showed indicators of oil stability and shelf life (Ahmed and Young, 1982; Branch *et al*., 1990). These two fatty acids can account for up to 80% of the totalfatty acids (Young and Walter, 1972; Abdel Rahman, 1982ab; Woodroof, 1983). (Sekhon *et al*., 1972) have shown that the high linoleic acid content, with its two unsaturated bonds, is undesirable because it decreases the shelf life of the product. Studies have also indicated high carbohydrates in newly germinated groundnut kernels, but the levels begins to fall at an average of 46%, 5 weeks as the seeds starts to store oil (Abdel Rahman, 1982ab).

Before the oil boom in Nigeria, there was the groundnut

pyramid in Jos, Northern Nigeria. The nutritive value of food was rich as the nut is affordable and use in diverse ways, with the oil boom, all focus is on the petroleum and little attention is given to the cultivation of the nut, which serve as good source of oil, protein, employment and export to the country.

The purpose of this study is aimed at evaluating the nutritional value of the seeds grown in Nigeria. This will aid promotion of the use of the nuts in the management of the nutrition-related problems in Nigeria in particular and in Africa in general. It consists of analyzing the moisture, crude protein, total lipids, ash and soluble nitrogen and total protein content in the defatted seeds elemental analysis of the mineral content. The physico-chemical characteristics of groundnut by extracting the oil from the groundnut seeds.

Materials and Methods

Sample collection and treatment: Shelled groundnut was collected from groundnut processing industries, transported in polythene bags to the laboratory, then sun dried for about two hours, later dried in an oven at 100-107°C, the red skins were removed squeezed with hand, craked into small pieces, placed in an airtight bottle and stored in the desiccator for analysis.

Assays: The moisture content was determined by drying in an oven at 100-107°C to constant weight (AOAC, 1980). The crude fat was determined by continuous extraction in a Soxhlet apparatus for 18h using hexane as solvent, ash by incinerating in a furnace at 550°C, crude fibre by sequential hot digestion of the defatted samples with dilute acid and alkaline solutions and total carbohydrate by difference according to (AOAC, 1980). The crude protein content was evaluated by digestion of the sample using Kjeldahl's method (Devani *et al.*, 1989) nitrogen determination by a spectrophotometric method described by (Devani *et al.*, 1989). All analysis were done in triplicate.

Elemental analysis: Atomic absorption spectrophotometer Buck 210 VGP, with computer readout was used, the elements of interest were Na, Mg, Zn, Fe, Ca, K and P. For phosphorus the Vanadate colorimetric by modified phosphomolybdate method was used.

Procedure: The phosphorus was determined as phosphate by the vanadium phosphomolybdate (vanadate) colorimetric method in which the phosphorus present as the orthophosphate reacted with the vanadate-molybdate reagent and produced a yellow orange complex, at absorbance of 420 nm. This modified colorimetric procedure was employ using 5% solution of molybdic acid in 10N sulfuric acid in a medium of 26% acetone by volume. The yellow complex formed by phosphate with vanadate and molybdate in acid has a high precision in the quantitative colorimetric determination of phosphorus. The mixed reagent of vanadate and molybdate was allowed to stay a few days before use, as it tends to precipitate. Only one molybdate was used in acid solution and acetone-water solution as the solvent. The former eliminates the need to age the reagent. The solvent, intensified the phosphomolybdate color and allowed complete solution of the organic phosphates. The extraction process was simplified by the use of water-soluble solvent (acetone). For complete color development, the final volume solution was as low as 30% and as high as 90% acetone by volume with very little change in color intensity which took place between the concentration. The color formed immediately and was stable for some hours and the phosphorus pentoxide was detected using the Klett-Summersion photoelectric colorimeter at 430 mμ.

Physico-chemical characteristics

Fatty acid determination using gas chromatography: Gas chromatography was used in which nonvolatile fatty acids were chemically converted to the corresponding volatile methyl esters. The resulting volatile mixture was analyzed by gas chromatography.

Procedure: About 2 grams of the oil was weighed, in a small beaker and dissolved in 50 mL of chloroform, transferred into a hundred volumetric flask and diluted to the mark with chloroform. 1 mL of the unknown sample was transferred into a 10 mL screw top culture tube with a Teflon liner. Exactly 1.00 mL of a standard solution of 0.814mg/ml pentadecanoic acid was then added. The glycerides in the oil sample was esterified as well as the pentadecanoicacid standard, the efficiency for esterification of the standards is the same as that of the glycerides, the response of the detector to each of the fatty acid methyl ester with the internal standard was the same, with this we were able to qualify the amount of each ester in the fat by comparing the integrated areas with the known concentration of the standard. Most of the chloroform was evaporated under a stream of nitrogen until-100 μL of the solution remained. 1 mL of interesterification reagent {25vol% of a 12% BF_3-methanol solution, 20vol% benzene and 55vol%methanol} was added. The tube was flushed with nitrogen, sealed and heated in a 100°C water bath for 30 minutes-after which the methyl esters was extracted with hexane and H_2O, the final mixture of the reagent, hexane and water were in the ratio 1:1:1 (adding 1 mL each of hexane and water to the reaction mixture). The mixture was shaken thoroughly for 2 minutes. A stable emulsion was formed which was broken by centrifugation. Half of the top hexane phase was transferred into a small text tube for injection.

The iodine value was determined by the WIJ's method already described by (Bansal *et al.*, 1993).

Table 1: Proximate composition %.and Fatty acid profile of groundnut

Composition	%
Moisture	5.8±0.04
Ash	3.8±0.06
Crude fibre	3.7±0.03
Crude protein	38.61±0.07
Fat	47.00±0.03
Carbohydrate	1.81±0.02
Myristic	18.80±0.04
Palmitic	8.17±0.03
Stearic	31.92±0.04

Table 2: Physico-chemical characteristics of Groundnut oil

Parameter	Value
Saponification value (mgKOH/g)	193.20
Iodine value (Wijs)	38.71
Acid value (mgKOH/g)	5.99
Free Fatty AcidsmgKOH/g	3.01
Peroxide value.	1.50
Refractive index	1.449

Table 3: Mineral content (mg/100g) of groundnut oil

Mineral	mg/100g
Na	42.00±0.71
K	705.11±0.86
Mg	3.98±0.04
Ca	2.28±1.94
Fe	6.97±1.62
Zn	3.20±0.11
P	10.55±0.68

Results and Discussion

Results of the proximate composition of the groundnut investigated is shown in Table 1. The moisture content is 5.80%, ash content 3.08%, crude fibre 3.70%, crude protein 38.61%, fat content 47% and carbohydrate (by difference) 1.81%. The fat, protein and ash contents are similar to the reports of Nelson and Carlos (1995) which indicated the fat content among 29 cultivars between 47.0%-50.1%, protein 26.3%-30.9%, ash 2.4-2.7%. The moisture content and crude fibre agreed with that of NAS (1980) of 5.0% and 3.0% respectively. The fat content is important in diets as it promotes fat soluble vitamin absorption. It is a high energy nutrient and does not add to the bulk of the diet. The crude fibre in this result indicates the ability of groundnut to maintain internal distention for a normal peristaltic movement of the intestinal tract; a physiological role which crude fibre plays. Diets low in crude fibre is undesirable as it could cause constipation and that such diets have been associated with diseases of colon like piles, appendicitis and cancer. The carbohydrate value by difference in this work is very low which shows that groundnut is more of a body building food.

Table 2 shows the physico-chemical properties of groundnut. The saponification value, of 193.20mgKOH/g agreed with Pearson's (1981), 187-196mgKOH/g. This property makes it useful in soap making. Iodine value 38.71g/100g indicates low degree of unsaturation and classified the oil as non-drying oil (80-100g/100g) as recorded for most edible oil, Pearson (1981). Acid value of 5.99mgKOH/g was close to Arachis (4.0mgKOH/g) by Pearson (1981) and Soyabean 4.279mgKOH/g (Akanni *et al.*, 2005). The free fatty acid is 3.0mgKOH/g, this indicate some percentage of fatty acid present in the oil and that the oil may likely undergo oxidation. The peroxide value 1.50meq/kg is not far from cotton seed oil of 2.5meq/kg (Popoola and Yangomodou, 2006). The low value indicates that the oil can resist lipolytic hydrolysis and oxidative deterioration. The refractive index, 1.449 showed that the oil contained some double bonds in its fatty acid composition as reported by Eromosele and Pascal (2003), that refractive index increases as the double bond increases.

Table 3, is the elemental composition in which the predominant elements are potassium, sodium and phosphorus, contrary to Wen-Hesin *et al.* (1997) which gave the most predominant elements as potassium, phosphorus, magnesium and calcium. The most abundant mineral K is expected because it is the most prominent mineral in Nigerian Agricultural products. The presence of calcium, magnesium, phosphorus is good indication that the groundnut is rich in the minerals for bone formation calcium is very essential in blood clothing muscles contraction and in certain enzymes in metabolic processes. Low Ca/P ratio facilitates calcinations of calcium in the bone while the Ca/P ratio above two helps to increase absorption of calcium in the small intestine. Also Na/K ratio is very important in the body for prevention of high blood pressure. Na/K ratio less than one is recommended. The Na/K ratio in this work is about 0.06, which is indicative that the groundnut is very good for human health and would probably prevent high blood pressure. The fatty acid profile in Table 1 showed the percentage of oleic acid 41.11% and palmitic acid 8.17% in good agreement with Nelson and Carlos'31.8%-46.6% oleic and 9.3%-13.35% palmitic. Presence of oleic acid showed double bond in the fatty acid.

Conclusion: Groundnut characteristically contained high level of oil and protein with low level of moisture, ash and carbohydrate, this makes it a potential source of edible oil. The high protein 38.61% of the defatted groundnut makes it good as cake for human consumption and useful as animal feeds. The low moisture content is an advantage when the shelf life is considered. The low ash content is indicative of low level of inorganic impurities and qualifies the oil as good source of mineral element. Though the saponification value is high, a property adequate for soap making industry, it is not attractive as a raw material because of its economic and nutritive implications. Low iodine value in the nut is the suitability for cooking while the peroxide

values are indicators of the ability to resist lipolytic and oxidative deterioration when stored. Elemental abundance speeds up metabolic process and improve growth and development (Akanni, 2005).

This work has enabled us to conclude that the nutritive value of groundnut seeds from Nigeria can be considered a good source of protein. The defatted seeds can be used to prepare food, as snacks, pastes and used in diets to prevent against some mineral deficiencies. This will aid to fight against malnutrition, especially protein-calorie, malnutrition, leading to better nutrition and health in Nigeria and Africa as a whole. Further research is being conducted to study the detailed physico-chemical composition of other kernel nuts and oils in Nigeria, the nutritional quality of the proteins and lipids.

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